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Using the triple-coincidence (LLS, PDD, & DAS) database tool

(1) Introduction

David Suszcynsky (dsuszcynsky@lanl.gov) has prepared and is currently maintaining a database of internal OLS coincidences, i.e. coincidences between the photodiode detector (PDD) and the CCD imager (LLS). This database contains the most robust LLS data along with the advantage of a fast light curve for each LLS-geolocated event. The reason the LLS data herein is robust (compared to LLS data lacking PDD corroboration) is that the PDD corroboration essentially removes the possibility of LLS pseudo-events caused by penetrating particles.

This note describes a further step I've done with Dave's internal OLS coincidences, namely to find and to document coincidences with the radio-frequency (only TATR) data which goes into FORTE's DAS. If you want to use this, I've provided a subroutine to access the triple-coincidence database.

(2) Caveat on the LLS/PDD coincidences included here

The PDD/LLS coincidences are validated on the basis of a peak in the histogram of {PDD timestamp - LLS timestamp}. Dave's database of internal OLS coincidences includes timestamp differences from -20 to +20 millisec. I have included in the triple database only those internal OLS coincidences for which the LLS timestamp lags the PDD timestamp by between +2.5 and +5.4 millisec. This coincides with the histogram peak for autonomous PDD collects, that is, for OLS operation in which PDD provides its own trigger independently of LLS.

(3) Data product

The triple coincidences are stored in day files, one file per day, in the subdirectory:

/n/projects/sat/idl/fpl

For example, a day file is /n/projects/sat/idl/fpl/19980601.fpl.

The triple coincidences in an fpl file are included out to +/- 200 millisec. The timestamp used for the OLS is the PDD timestamp, which is more meaningful than is the LLS timestamp. The actual coincidences are those which occur in the range

$$-0.0001 \text{ s} < \text{tdif} < +0.0004 \text{ s}$$

Within this range, the statistical false correlation rate in only on the order of 1%, so you can use the geolocations (deriving from LLS) quite reliably on the rf data.

The other entries in the fpl files are included so that the flash environment can be captured, i.e., DAS events from the same flash, or internal OLS coincidences from the same flash.

The dayfile is read by an IDL subroutine called “readfpl.pro”, which is being placed on the common area for FORTE users;

```
+
;This reads an unformatted coincidence file (ols and vhf within
;+/- 200 millisec) and places the params into arrays.
;
;Input:
;       fplfile=string const or variable indicating full path to fpl file
;
```

;Outputs:
; nglob=number of events in parent lgu file (not essential info)
; icount=number of lgu events in lat-lon-date cube
; jcount=number of lgu events in cube within ols epoch
; mcount=number of olss within the jcount-vhf events' epoch..
; nc=number of coincidences within +/- 200 milliseconds found..
;The following outputs are all arrays of long dimension =nc:
; olsh=UT hour bytarr(nc)
; olsm=UT minute bytarr(nc)
; olss=UT seconds fltarr(nc)
; olslat=north lat (deg) fltarr(nc)
; olslon=east longitude (deg) fltarr(nc)
; tdif=ols-vhf time dif (sec) dblarr(nc)
; pddenergy=integrated PDD energy (microjoules/square meter)
; pddweff=effective width (sec) of PDD pulse
; pddlongday=long-integer for yymmdd, e.g., "19971101" of parent PDD file
; pddlongsec=long-integer for hhmmss, e.g. "182216" of parent PDD file
; pddnth=event number "nth" in parent PDD file.
; llsnp=number of pixels participating in detection by LLS
; llsenergy=LLS detected energy (engineering units) summed over pixels
;   (mult by 0.000057 to get "best guess" microjoules/square meter)
; longday=long-integer for yyyymmdd, e.g. "19971101" of parent das file
; longsec=long-integer for hhmmss, e.g. "182216" of parent das file
; nth=event number ("nth" in call to fql) in parent das file
; nsamples=long-int number of samples in event in parent das file
; longi=east longitude report (deg) in parent das file
; lati=north latitude report (deg) in parent das file
; alti=altitude report (km) in parent das file
; lsec=long-int elapsed GPS seconds of event (use in es2str)
; dsec=double-precision remainder GPS sec (use in es2str)

;	freqa=float center frequency of TATRA band (12 MHz above band bottom)
;	freqb=float center frequency of TATRB band (12 MHz above band bottom)
;	bpa1=byte elog.preamp1
;	bpa2=byte elog.preamp2
;	bpbu=byte elog.buantpwr
;	bat=bytarr(2,nglob) =elog.anttype
;	bcode=byte elog.trigsrccode
;	nb=long-int number of TATR samples before trigger
;	bpa=byte elog.tatra.power
;	bpb=byte elog.tatrb.power
;	baa=byte elog.tatra.antenna
;	bab=byte elog.tatrb.antenna
;	nsub=number of subsamples (128 TATR samples, moved 128/16 forward)
;	subsamp=time step (millisec) between subsamples
;	atec=TATRA fitted slant TEC in units of 10**17 m**-2
;	btec=TATRB fitted slant TEC in units of 10**17 m**-2
;	contrasta=peak:med power ratio of pre-whitened, dechirped TATRA
;	contrastb=peak:med power ratio of pre-whitened, dechirped TATRB
;	widtha=1/e width (millisec) of pri. peak, TATRA clean autocor.
;	widthb=1/e width (millisec) of pri. peak, TATRB clean autocor.
;	snra=snr of secondary peak (0 if not tallied) of TATRA clean autocor.
;	snrb=snr of secondary peak (0 if not tallied) of TATRB clean autocor.
;	powa=avg power ((v/m)**2 onto satellite) for TATRA
;	powb=avg power ((v/m)**2 onto satellite) for TATRB
;	powpeaka=peak ((v/m)**2 onto satellite) for TATRA
;	powpeakb=peak ((v/m)**2 onto satellite) for TATRB
;	splita=delay (millisec) for second pulse wrt first for TATRA tipps
;	splitb=delay (millisec) for second pulse wrt first for TATRB tipps
;-

The call to readfpl is made as follows:

```
readfpl,fplfile,nglob,icount,jcount,mcount,nc,$
olsh,olsm,olss,olslat,olslon,tdif,pddenergy,pddweff,$
pddlongday,pddlongsec,pddnth,llsnp,llsenergy,$
longday,longsec,nth,nsamples,longi,lati,alti,$
lsec,dsec,freqa,freqb,bpa1,bpa2,bpbu,bat,bcode,nb,bpa,bpb,baa,bab,nsub,$
subsamp,atec,btec,contrasta,contrastb,widtha,widthb,snra,snrb,$
powa,powb,powpeaka,powpeakb,splita,splitb
```

(You should paste this into any code you're writing, to avoid having to type the whole thing….)